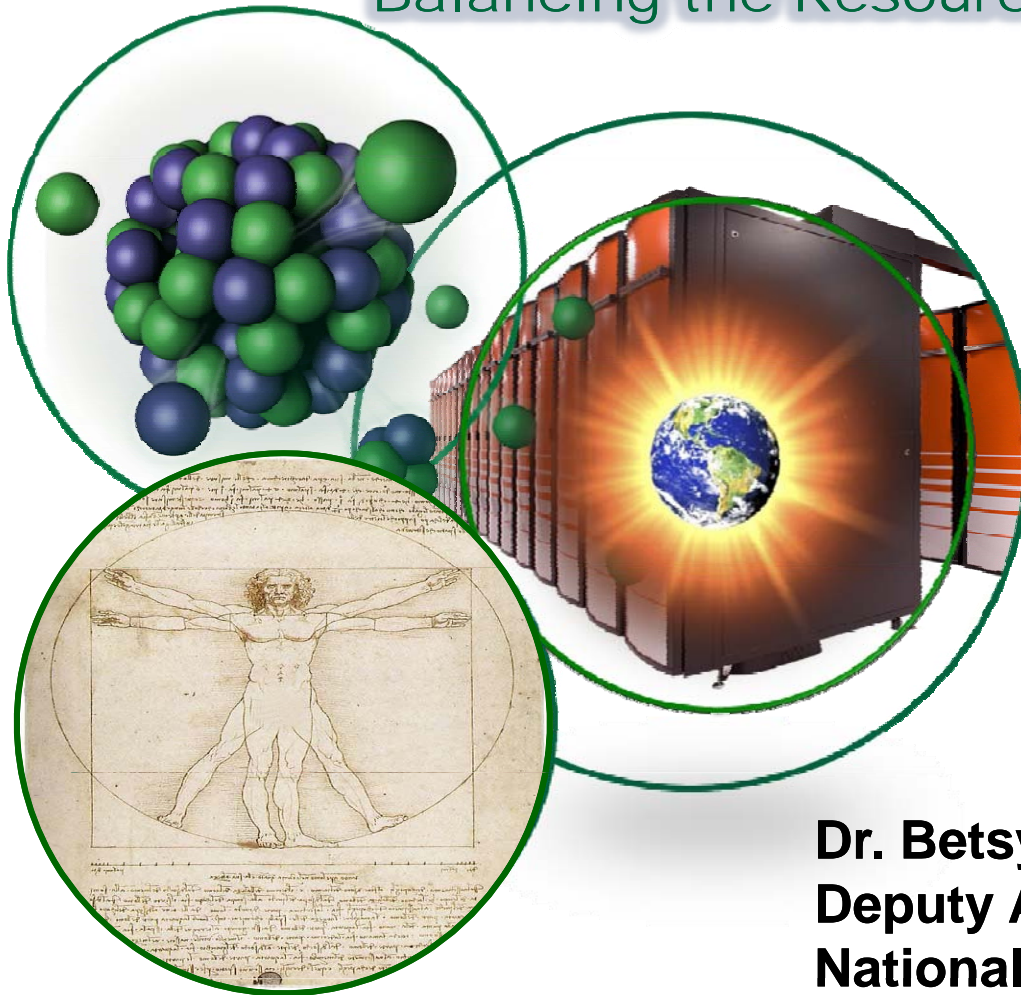# Resource Assurance
Balancing the Resource Equation

Presented to

EUCOM/AFRICOM
S&T Conference

Dr. Betsy Cantwell
Deputy Associate Laboratory Director
National Security Directorate
Oak Ridge National Laboratory
June 2009

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Report Documentation Page			*Form Approved* *OMB No. 0704-0188*
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1. REPORT DATE **JUN 2009**	2. REPORT TYPE		3. DATES COVERED **00-00-2009 to 00-00-2009**
4. TITLE AND SUBTITLE **Resource Assurance Balancing the Resource Equation**			5a. CONTRACT NUMBER
			5b. GRANT NUMBER
			5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)			5d. PROJECT NUMBER
			5e. TASK NUMBER
			5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Oak Ridge National Laboratory,National Security Directorate,PO Box 2008,Oak Ridge,TN,37831**			8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**			
13. SUPPLEMENTARY NOTES **See also ADM202744. Presented at the European Command and African Command Science and Technology Conference held in Stuttgart, Germany on 8-12 Jun 2009**			
14. ABSTRACT			
15. SUBJECT TERMS			

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**45**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

Today, ORNL is DOE's largest science and energy laboratory

- $1.5B budget
- 4,550 employees
- 3,900 research guests annually
- $350 million invested in modernization

- World's most powerful open scientific computing facility
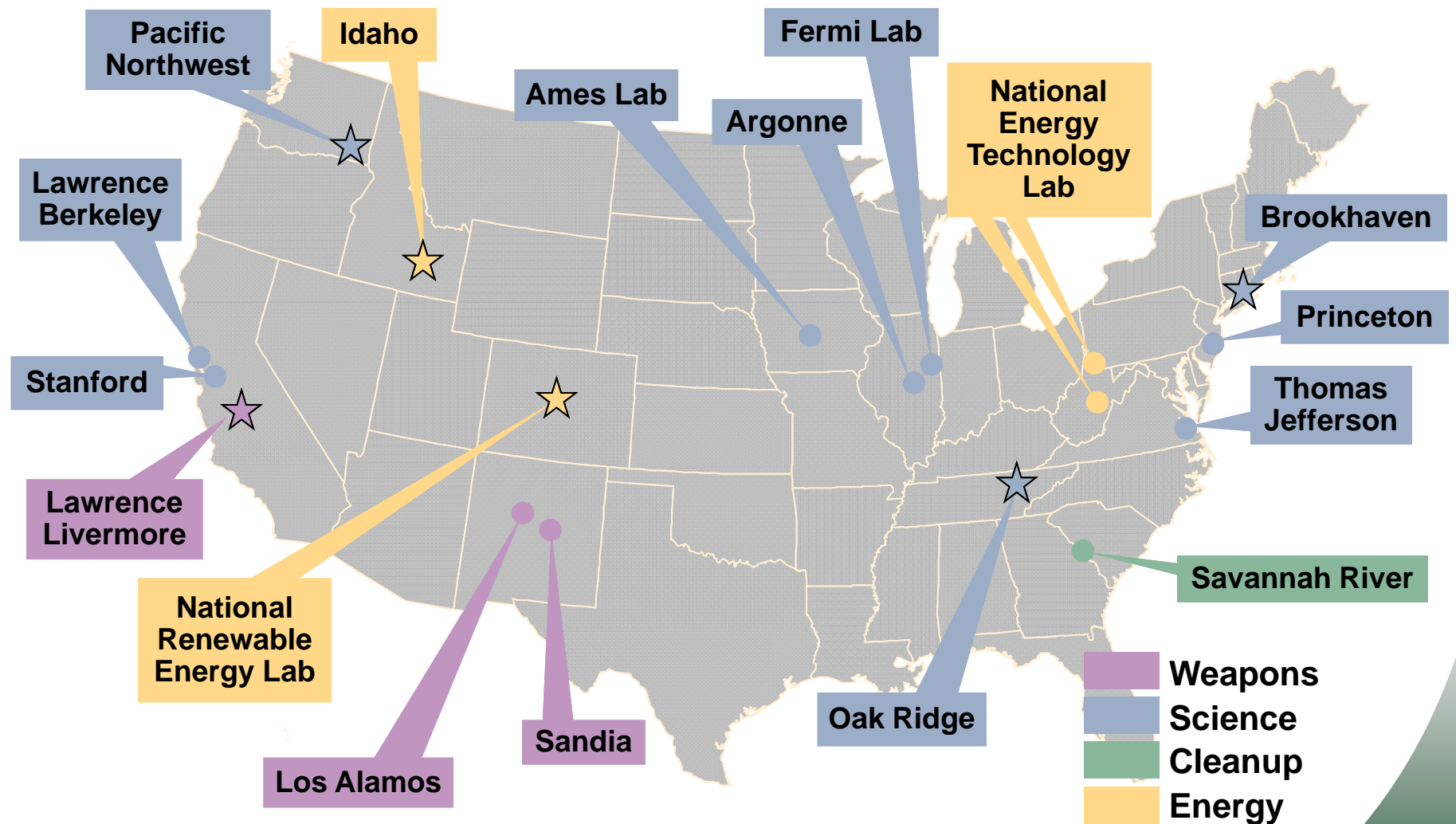- Nation's largest concentration of open source materials research

- Nation's most diverse energy portfolio
- Operating the world's most intense pulsed neutron source
- Managing the billion-dollar U.S. ITER project

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The Department of Energy's national laboratories:
A comprehensive research system

- Pacific Northwest
- Idaho
- Ames Lab
- Fermi Lab
- Argonne
- National Energy Technology Lab
- Brookhaven
- Lawrence Berkeley
- Princeton
- Stanford
- Thomas Jefferson
- Lawrence Livermore
- National Renewable Energy Lab
- Los Alamos
- Sandia
- Oak Ridge
- Savannah River

Legend:
- Weapons
- Science
- Cleanup
- Energy

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Energy

- **The world's largest industry**

- **The number one challenge facing humanity**

- **A key element of the resource challenge**

- **A principal driver for global stability**

    - **Climate change**

    - **National security**

    - **Economic competitiveness**

    - **Quality of life**

- **Compels nation-state behavior**

- **Creates Environmental concerns**

- **Stresses Trade Relationships**

- **There will be an "Energy Trip-wire"**

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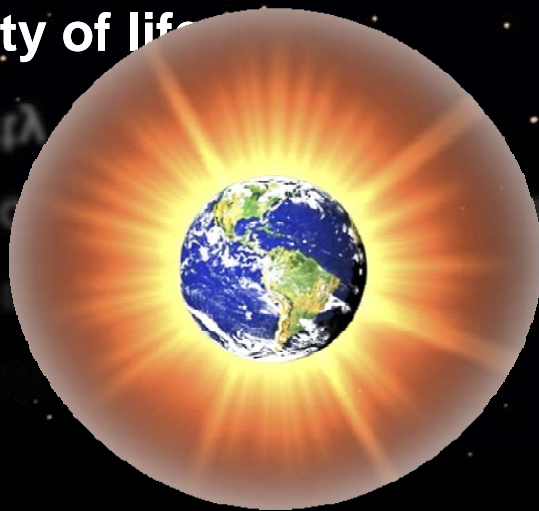
Water

- **Essential for human life**

- **Essential for agriculture**

- **Essential for energy production**

- **Historical ingredient of political stability**
  - **Availability**
  - **Security**
  - **Economic competitiveness**
  - **Quality of life**

  - **"Water wars and confrontations"**
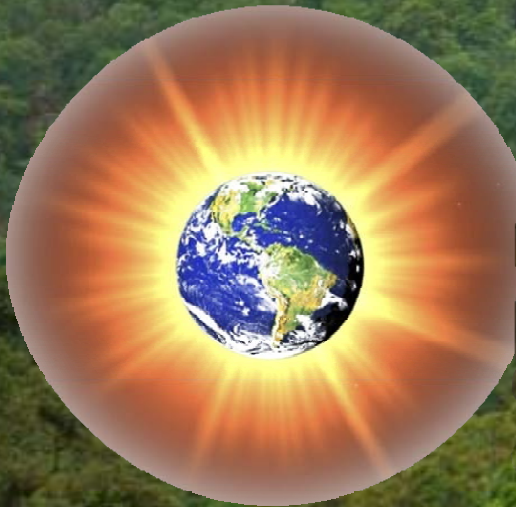 - **Waste is an environmental concern**

Resource Assurance

Balancing the Resource Equation

Energy + Water + Waste + Land-Use

How mankind manages the resources challenge will determine the quality and sustainability of the human - habitat interface.

Interface interrelationships must be understood in detail, in particular the impacts and trade-offs of Energy vs Water vs Waste vs Land-Use.

The Resource Assurance Approach

Tools for scenario-based "Systems-of-systems" analyses to understand the complex linkages, challenges, and temporal interdependencies of:

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The Resource Assurance Approach

Tools for scenario-based "Systems-of-systems" analyses to understand the complex linkages, challenges, and temporal interdependencies of:

- **Present and Future Energy Needs**

- **Water Availability**

- **Waste, Land-Use & Human Footprints on the Environment**

- **Climate Change Impacts**

- **Demographic Factors**

- **Natural Disasters**

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The Resource Assurance Approach

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- *Resources*
- *Environment*
- *Economic development*
- *Security concerns*
- *Policy & regulation*
- *Technology*

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The Resource Assurance Approach

- The energy crisis is also a opportunity

- Energy is a significant component of the resource challenge:

  Energy + Water + Waste + Land-Use

- Gaps in understanding can result in poor decisions

- Decisions effect infrastructure - expensive to correct

- Modern computers, methods, and advancing science now enable evaluation of multiple conflicting scenarios through modeling & simulation, knowledge extraction and data assimilation

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The Resource Assurance Construct

Good Decisions

• **Avoid or mitigate resource instigated conflicts**

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The Resource Assurance Construct

Good Decisions

- Avoid or mitigate resource instigated conflicts
- Uses capital productively and efficiently

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The Resource Assurance Construct

Good Decisions

- Avoids or mitigates resource instigated conflicts
- Uses capital productively and efficiently
- Build future prosperity with business models that yield a healthy environment and new business sectors that support its maintenance

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The Resource Assurance Construct

- ○ **Avoids or mitigates resource instigated conflicts**
- **Uses capital productively and efficiently**
- **Underpinning future prosperity with a healthy environment and new businesses for its maintenance**
- **Solutions from test cases can be applied worldwide**

The Resource Assurance Construct

Good Decisions

- Avoids or mitigates resource instigated conflicts
- Uses capital productively and efficiently
- Underpinning future prosperity with a healthy environment and new businesses for its maintenance
- Solutions from test cases are reproducible worldwide
- **Derive from multiple functional partnerships to capture, combine and deliver capabilities**

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Producing Resource Assurance Analyses

- **DOE-scale Modeling and Simulation**
  - **High Performance Computing**

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Producing Resource Assurance Analyses

- **DOE-scale Modeling and Simulation**
  - **High Performance Computing**

- **Energy, environment, and biosciences technologies, capabilities and expertise**
  - **Examples include**
    - **Climate change analyses**
    - **Bioenergy centers**
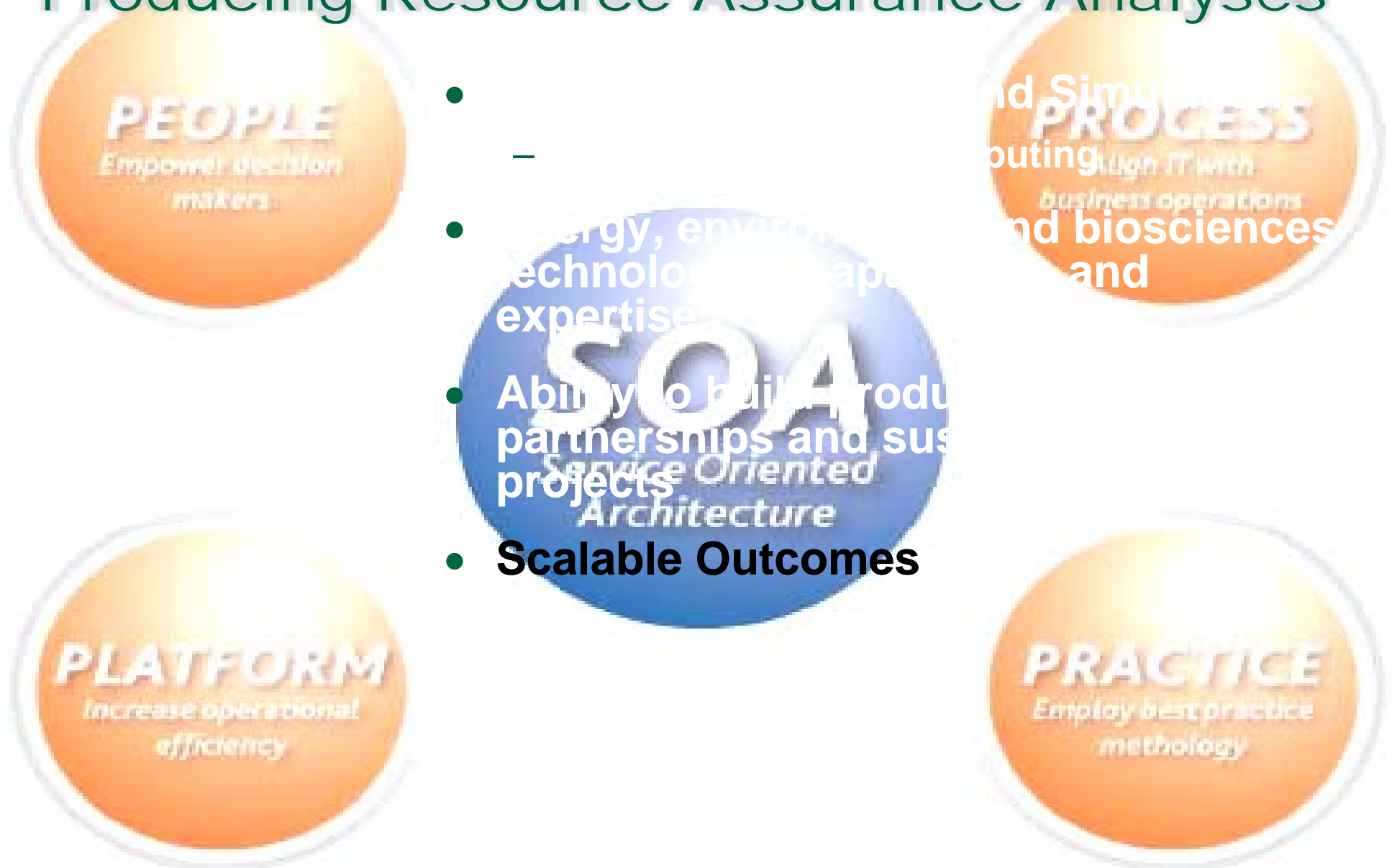   - **Human population distribution changes due to climate changes or new energy technologies**

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Producing Resource Assurance Analyses

- ●

  - –

- ● E~~n~~~~ment, and bios~~
  tech~~s, capa~~ and
  exp~~

- ● **Ability to build productive
  partnerships and sustain collaborative
  projects**

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Producing Resource Assurance Analyses

- _____ nd Simulation
  - _____ puting

- ____ergy, enviro____ ____ nd biosciences
  _echnolog____ ____apa____ and expertise

- Abil____ ____o bui____ rodu____
  partnerships and sus____
  projects

- **Scalable Outcomes**

PEOPLE
Empower decision makers

PROCESS
____lign IT with business operations

PLATFORM
Increase operational efficiency

PRACTICE
Employ best practice methology

SOA
Service Oriented Architecture

Outcomes must be scalable, and our approach is the development of a SOA

Producing Resource Assurance Analyses

- **DOE-scale Modeling and Simulation**
  - **High Performance Computing**
- **Energy, environment, and biosciences technologies, capabilities and expertise**
- **Ability to build productive partnerships and sustain collaborative projects**
- **Scalable Outcomes**
- **Exportable tools and networked connectivity enabling worldwide use, both classified and unclassified**

PNNL

NCSA

PSC

NERSC

ORNL

SDSC

ESnet

Teragrid

UltraScience Net / NLR

Internet2

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The Resource Assurance Construct

- A long view - ten to fifty years global view– with near-term deliverables

The Resource Assurance Construct

- A long view - ten to fifty years global view– with near-term deliverables
- Technology – Policy assessment

The Resource Assurance Construct

- A long view - ten to fifty years global view– with near-term deliverables
- Technology – Policy assessment
- Systems thinking and interaction

The Resource Assurance Construct

- A long view - ten to fifty years global view– with near-term deliverables
- Technology – Policy assessment
- Systems thinking and interaction
- Capitalize on many technology futures

  - Renewable energy
    (hydro, solar, wind, bio, land-use)

  - Resources efficiency
    (zero energy homes, electric transportation, low-water-use technologies, waste-to-energy, remanufacturing)

  - Energy Base Load (Fossil fuels + nuclear)

  - Efficient, reliable distribution (Grid)

Resource Assurance Construct
Characterization of the Resource Equation

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Resource Assurance Construct
Characterization of the Resource Equation

Creates and sustains Geospatially Enabled Unclassified and Classified "Resource Globes"

- *Allows development of accurate region specific assessments*
- *Evaluation of the dynamics of energy-water-waste cycles*
- *Supports course of action analysis and decision making*

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Resource Assurance Construct

Characterization of the Resource Equation

Collaborative team builds the foundation models…

- **Energy Systems**
- **Water**
- **Pollution**
- **Climate Change**
- **Population**
- **Natural Disasters**

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Resource Assurance Construct

Characterization of the Resource Equation

Collaborative team builds the foundation models…

…for the customer set striving to understand the resource equation

- **Energy Systems**
- **Water**
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- **DOD-COCOMS**
- **DOE**
- **DHS**
- **CDC**
- **NSF**
- **Universities**

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Commercial Interface Models

Environment
Economics
Security
Policy
Technology

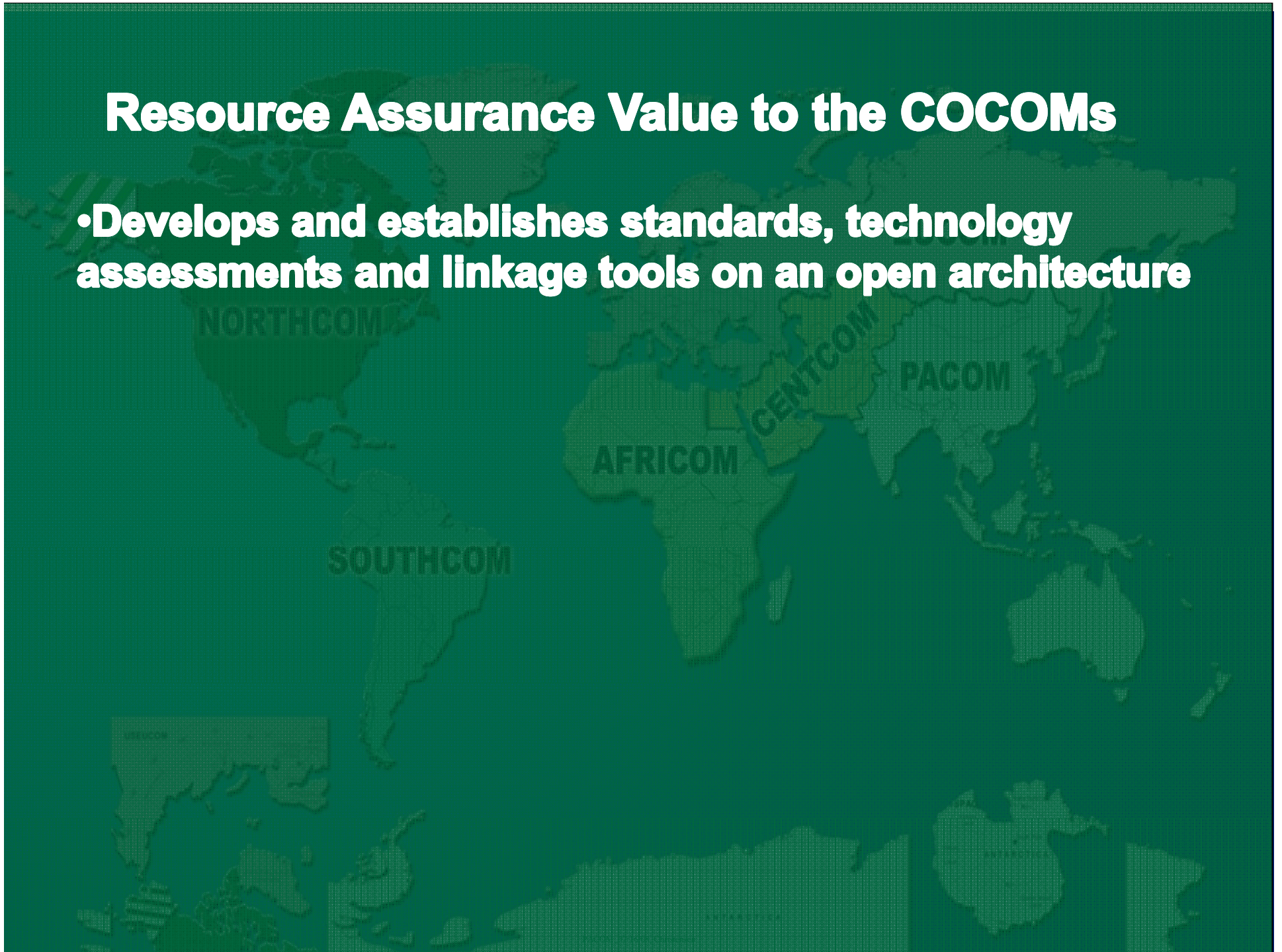- **DOD-COCOMS**
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Resource Assurance Value to the COCOMs

- Develops and establishes standards, technology assessments and linkage tools on an open architecture

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- Outlines a "resource framework", to provide a standard process for technology and policy assessment

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- Provides system network architectures that define data-storage-mining-processing and visualization science techniques

Resource Assurance Value to the COCOMs

- Develops and establishes standards, technology assessments and linkage tools on an open architecture

- Outlines a "resource framework", to provide a standard process for technology and policy assessment

- Provides system network architectures that define data-storage-mining-processing and visualization science techniques

- Provides a modeling and simulations backbone to examine alternative policy and technology strategies

Resource Assurance will Help Guide Technology Selection and Strategy

- **The power of Resource Assurance is the ability to see the synergistic impact of multiple technology combinations and development decisions.**

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Resource Assurance will Help Guide Technology Selection and Strategy

- Identify a broad number of resource capabilities that will drive technology selection with the power to see the synergic impact of multiple technology combinations and development decisions.

- Expand the ability of communities and organizations to determine the technology alternatives that can best satisfy resource needs within a dynamic updated framework.

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Resource Assurance will Help Guide Technology Selection and Strategy

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- Expand the ability of communities and organizations to determine the technology alternatives that can best satisfy resource needs within a dynamic updated framework.

- Select the best technology from multiple alternatives.

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Resource Assurance will Help Guide Technology Selection and Strategy

- Identify a broad number of resource capabilities that will drive technology selection with the power to see the synergic impact of multiple technology combinations and development decisions.

- Expand the ability of communities/regions to determine the optimal combination of technology alternatives that can best satisfy resource needs within a dynamically updated framework.

- Select the best technology options from multiple alternatives.

- Generate, implement and keep updated plans to develop and deploy appropriate resource technology alternatives.

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Oak Ridge, TN 37831
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Resource Assurance…

…Balancing the Resource Equation

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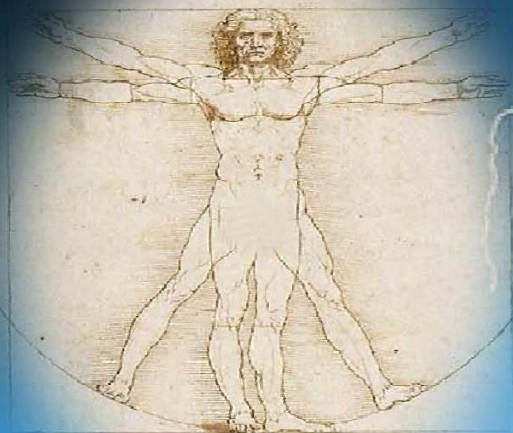
Resource Assurance Status

- **Year Integrated Project Plan**
  - **Unclassified and Classified Components**

- **Focused to COCOM needs**
  - **PACOM- Resource challenges identified**
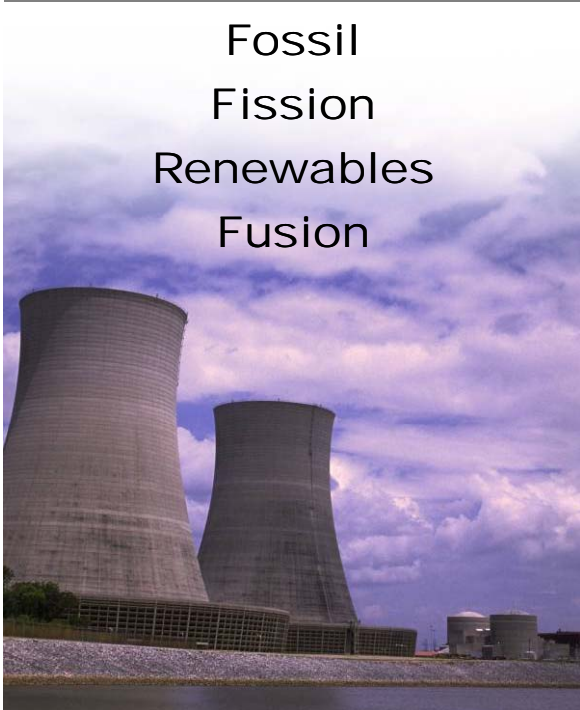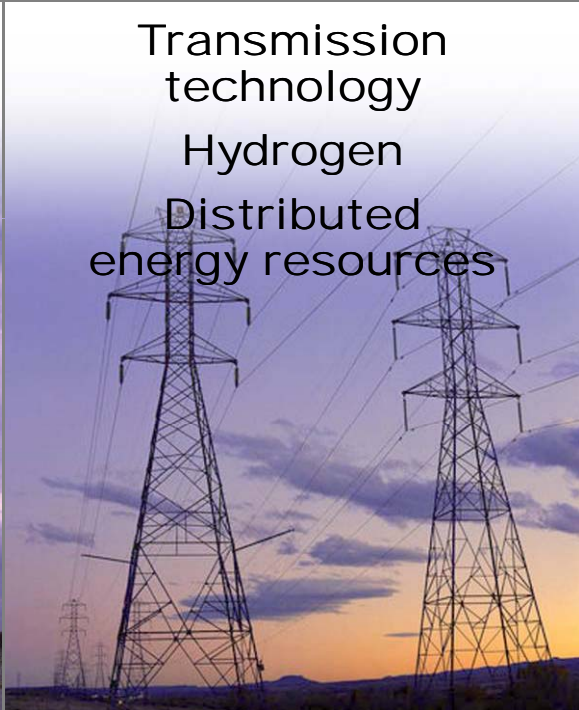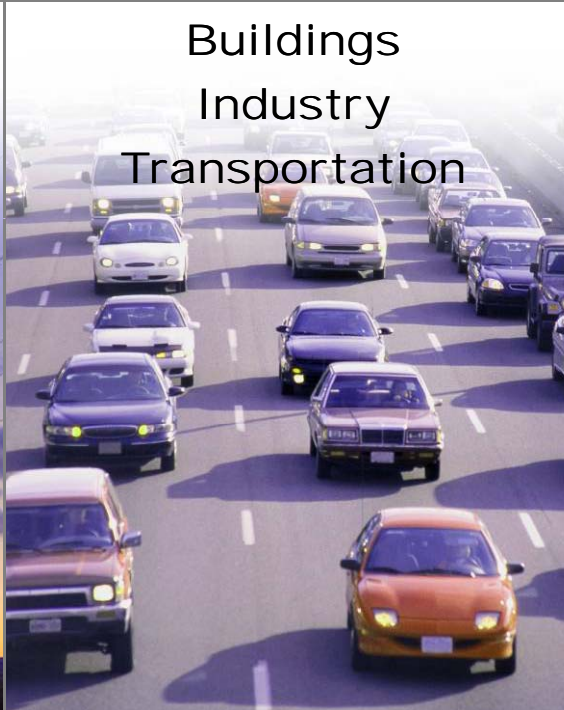 - **Theater Support Plan interface**

- **National Laboratory and University Team identified & working**
  - **April 2009 Roles and Missions Session**
  - **May- June 2009 Operational Needs Statement**
  - **July 2009 Team meeting complete project plan**

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Translating science and technology into energy solutions

Generation	Distribution	Consumption
Fossil	**Transmission technology**	**Buildings**
Fission	**Hydrogen**	**Industry**
Renewables	**Distributed energy resources**	**Transportation**
Fusion		

**Supporting national goals
for energy security and independence**

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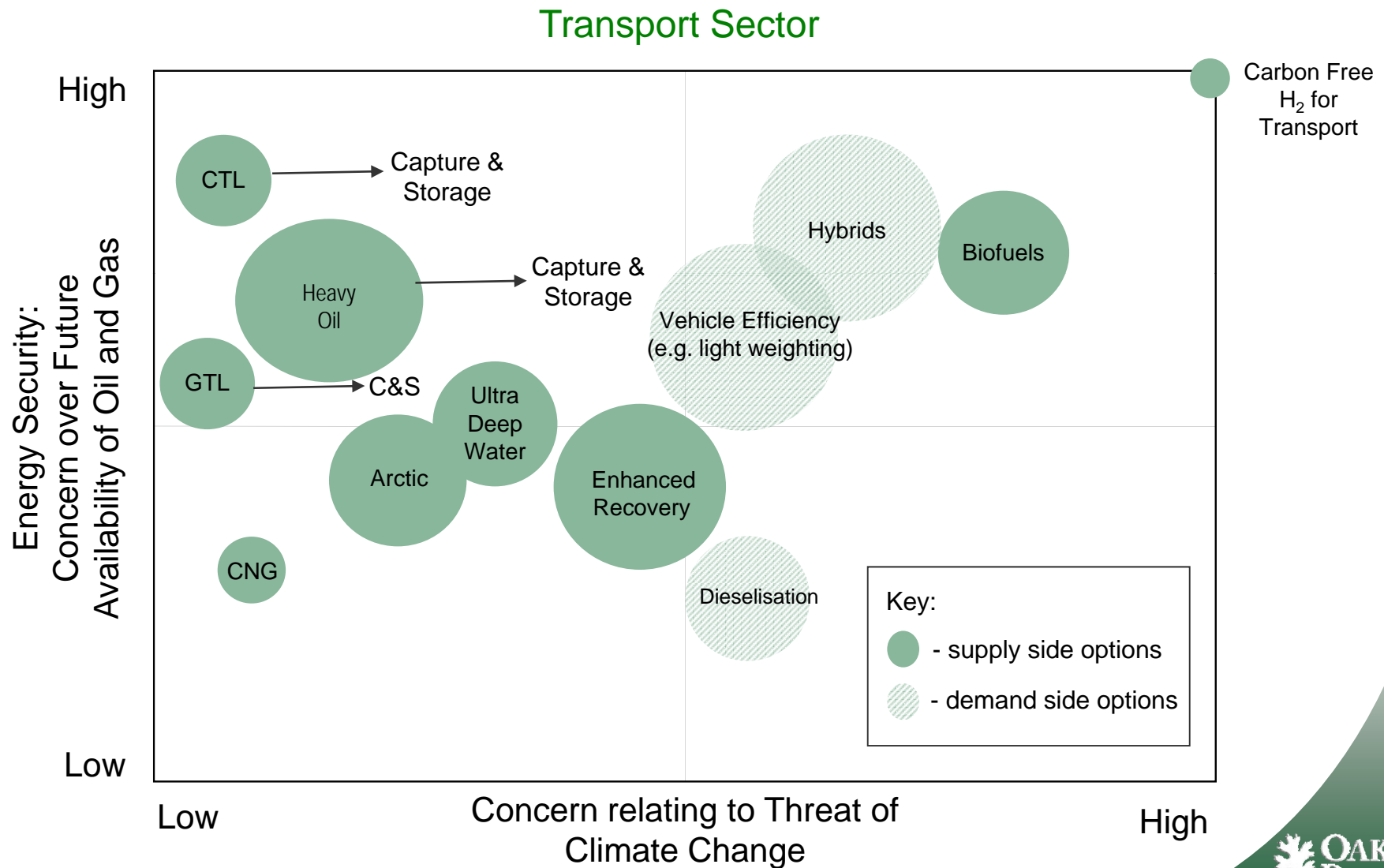
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The Energy-Carbon-Water Nexus

Sustainable production and use of interrelated resources on a constrained and changing Earth

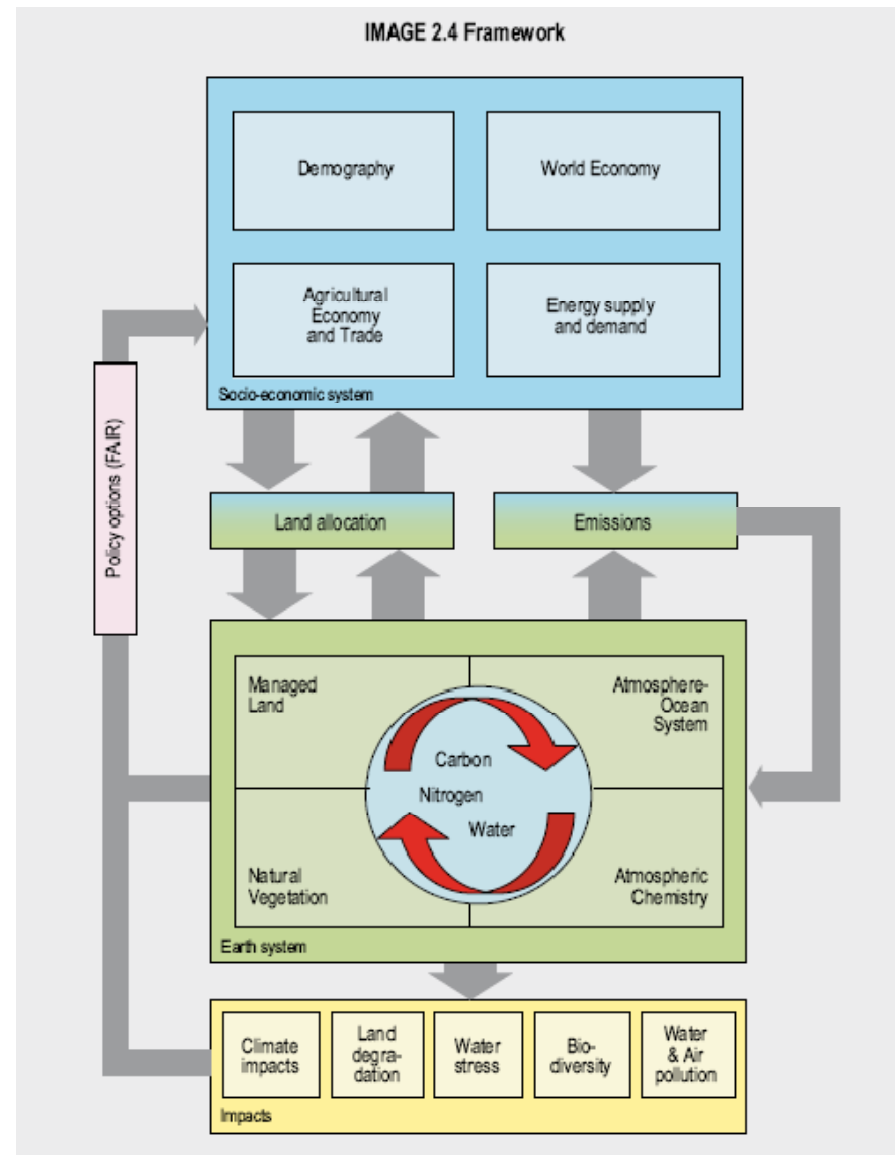| Energy	Carbon	Water
• Production, distribution, and use • Economic drivers • Environmental drivers	• Biofuel, food, fiber • Ecosystem health (e.g., biodiversity) • Managing carbon for mitigation of climate change	• Energy requires water; Water requires energy • Many critical climate change impacts are water related

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Technology Options for Transportation (Source: Koonin, BP)

Transport Sector

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Sustainability Science: Integrating energy, economics, and environment

- ● **Regional to global scales**
  - – Even molecular indicators

- ● **Level of detail driven by needs**

- ● **Data and computing limitations are disappearing**

IMAGE 2.4 Framework

Policy options (FAIR)

Socio-economic system: Demography, World Economy, Agricultural Economy and Trade, Energy supply and demand

Land allocation — Emissions

Earth system: Managed Land, Atmosphere-Ocean System, Carbon Nitrogen Water, Natural Vegetation, Atmospheric Chemistry

Impacts: Climate impacts, Land degradation, Water stress, Bio-diversity, Water & Air pollution

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Regional Simulation Model (RSim)

- **Spatially explicit**
- **Forecast outcomes of management options**

(*Fort Benning shown here*)

Scenarios influence RSim

1998

Projected

Legend:
- Beaches/Dunes/Mud
- Open Water
- Transportation
- Utility Swaths
- Low Intensity Urban
- High Intensity Urban
- Clearcut/Sparse
- Quarries/Strip Mines
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Golf Courses
- Pasture
- Row Crop
- Forested Wetland

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